OPTICAL TRANSMITTER-RECEIVER

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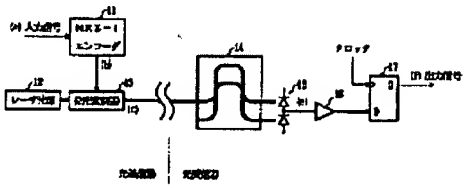
- European:
Application number: JP19980318105 19981109
Priority number(s): JP19980318105 19981109

Abstract of **JP2000151505**

PROBLEM TO BE SOLVED: To avoid waveform deterioration dependent on a mark rate by providing an optical receiver with a Mach-Zehender interferometer, a balance type light receiver for photoelectric converting a signal light from the Mach-Zehender interferometer and a three value decision discriminator which identifies a signal sequence of an AMI code the balance type light receiver outputs and converts it into an NRZ code. SOLUTION: A Mach-Zehender (MZ) interferometer 14 is set so that an output of a balance type light receiver 15 becomes not an NRZ code but an AMI code and the AMI code outputted from the balance type light receiver 15 is identification reproduced by a three value decision discriminator 17. Since the AMI code has a feature that it has a ground level when '0' and a plus amplitude and a minus amplitude are alternately outputted when '1', it does not essentially have an AC component. Thus, even if an optical receiver is constituted by an AC connection system, waveform deterioration dependent upon a rate of mark does not occur and stable reception is enabled for any input signals.



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Ｇ０２Ｂ　6/122		Ｃ０２Ｆ　2/00		２Ｋ００２
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Ｈ０４Ｂ　10/152		Ｃ０２Ｂ　6/12	Ｄ	５Ｋ００４
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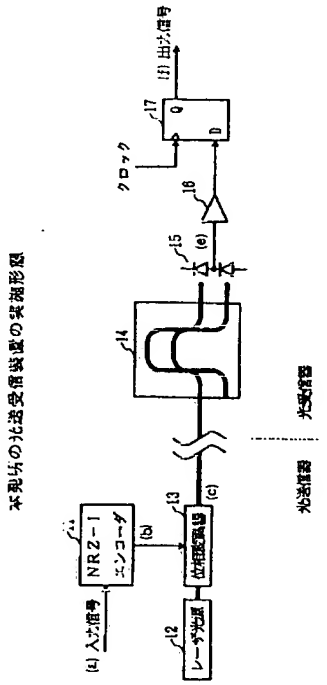
(54)【発明の名称】　光送受信装置

(57)【要約】
【課題】　識別回路に入力する信号列がＡＭＩ符号になるＤＰＳＫ－ＤＤ方式を実現し、マーク率に依存した波形劣化を回避する。
【解決手段】　光送信器は、ＮＲＺ符号の入力信号をＮＲＺ－Ｉ符号の信号に変換するエンコーダと、符号化されたマークとスペースに対して、位相振幅Δφを０＜Δφ＜πの範囲で与えた位相変調光を出力する位相変調器とを備え、光受信器は、受信した位相変調光を２分岐し、一方の信号光に対する遅延ビット長Ｄを０＜Ｄ＜２の範囲で設定し、両信号光を干渉させて強度変調光に変換し、かつ両信号間の位相差Δθが０のときに２出力の光強度が等しくなるように調整されたマッハツェンダ干渉計と、その２出力からの信号光を光電変換した電気信号の差分を出力するバランス型受光器と、バランス型受光器から出力されるＡＭＩ符号の信号列を識別してＮＲＺ符号の信号列に変換する３値判定識別器とを備える。



【0010】また、スクランブラを用いた図7の構成は、任意の符号列に対して万能に光伝送品質を補償できるわけではなく、確率は小さいがある限られた条件下では光伝送品質を補償することができず、光受信時に同期はずれやビット誤りを発生する可能性がある。さらに、SONET/SDHスクランブラとSONET/SDHデスクランブラにおいて、疑似ランダムパターンの始まりを一致させるために、スクランブラ-デスクランブラ間でフレーム同期をとる必要がある。

【0011】一方、nBmBエンコーダを用いた図8の構成では、エンコーダから出力される信号列のビットレートはエンコーダに入力される信号列のビットレートの1.25倍となり、伝送効率が2割程度低下してしまう。

【0012】本発明は、上記の問題点を解決するために、識別回路に入力する信号列がAMI (Alternate Mark Inversion) 符号になるDPSK-DD方式を実現し、マーク率に依存した波形劣化を回避することができる光送受信装置を提供することを目的とする。

【0013】

【課題を解決するための手段】本発明は、差動符号化された位相変調光を出力する光送信器と、この位相変調光を受光して復調する光受信器とを備えた光送受信装置において、光送信器は、NRZ符号の入力信号をNRZ-I符号の信号に変換するエンコーダと、エンコーダによって符号化されたマークとスペースに対して、位相振幅$\Delta\phi$を$0<\Delta\phi<\pi$の範囲で与えた位相変調光を出力する位相変調器とを備え、光受信器は、受信した位相変調光を2分岐し、一方の信号光に対する遅延ビット長Dを$0<D<2$の範囲で設定し、両信号光を干渉させて強度変調光に変換し、かつ干渉した両信号間の位相差$\Delta\theta$が0のときに2つの出力ポートから出力される光強度が等しくなるように調整されたマッハツェンダ干渉計と、マッハツェンダ干渉計の2出力ポートからの信号光を光電変換し、変換された電気信号の差分を出力するバランス型受光器と、バランス型受光器から出力されるAMI符号の信号列を識別してNRZ符号の信号列に変換する3値判定識別器とを備える。

【0014】また、位相変調器で与えられる位相振幅$\Delta\phi$を$\pi/2$に設定することが好ましい。

【0015】

【発明の実施の形態】図1は、本発明の光送受信装置の実施形態を示す。図において、光送信器は、NRZで符号化された入力信号をNRZ-I符号に変換するNRZ/NRZ-Iエンコーダ11、レーザ光源12、位相変調器13により構成される。光受信器は、受信光信号の位相差に応じた強度変調光に変換するマッハツェンダ(MZ)干渉計14、バランス型受光器15、線形増幅器16、3値判定識別器17により構成される。

【0016】本実施形態の特徴は、バランス型受光器15の出力がNRZ符号ではなくAMI符号になるようにMZ干渉計14を設定し、バランス型受光器15から出力されたAMI符号を3値判定識別器17で識別再生するところにある。

【0017】ここで、本実施形態の動作について、従来のDPSK-DD方式と対応させて説明する。なお、DPSK-DD方式は、入力信号が「1」の場合には直前の符号を反転した符号、「0」の場合には直前の符号と等しい符号となるNRZ-I符号の信号を生成し、このNRZ-I符号の信号で無変調光を位相変調して送信し、受信側ではこの位相変調光をバランス型受光器で直接検波する方式である。

【0018】従来のDPSK-DD方式の場合、MZ干渉計で干渉したビット間の位相差$\Delta\theta$が0の時に、MZ干渉計の2つの出力ポートの一方のみが光を出力するようにMZ干渉計を調整する。この場合のMZ干渉計出力の干渉ビット間位相差$\Delta\theta$依存性を図2に示す。図2は、位相変調器によって与えられる位相振幅$\Delta\phi$をπ、遅延ビット長Dを1ビットとし、$\Delta\theta$が0の時にポート2に光が出力するよう設定した場合を示しており、$\Delta\theta$がπと$-\pi$になった時にはポート1に光が出力される。これをバランス型受光器で受光すると、受光器の出力はNRZ符号信号列となる。

【0019】図4は、NRZ符号信号列が再生されるまでの信号波形の変化の様子を示す。NRZ符号の入力信号(a)は、エンコーダによってNRZ-I符号化された信号(b)に変換され、位相変調器によって位相振幅$\Delta\phi=\pi$で位相変調されて位相変調信号ϕ_t (c)となる。この信号列の隣合ったビット間の位相差($\phi_t-\phi_{t-T}$) (d)は、π、0、$-\pi$の3値符号信号列となるので、図2のように設定されたMZ干渉計で干渉させ、バランス型受光器で受光すると、その出力は図のようなNRZ符号の出力信号(e)となる。

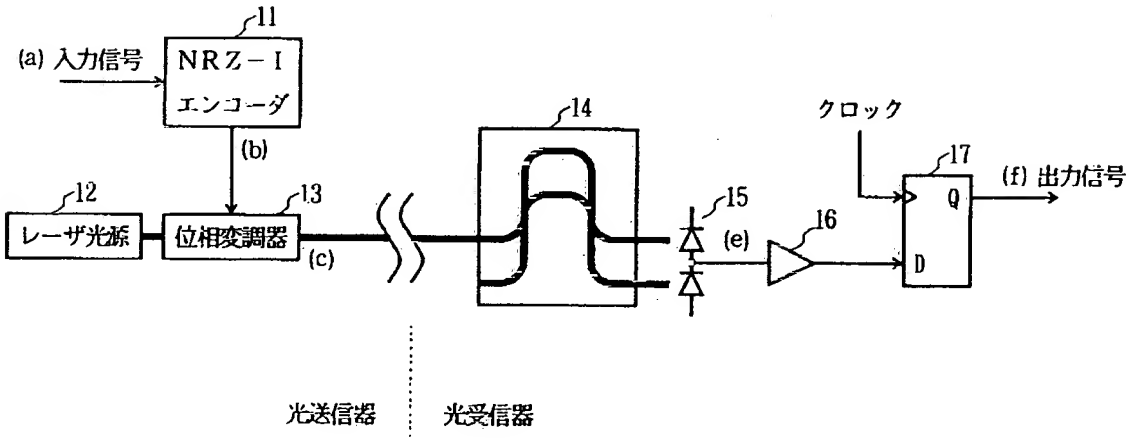
【0020】さて、再生されたNRZ符号信号列は、D-FF等の2値判定識別回路を用いて識別再生が行われるが、仮に入力信号列のマーク率が大きく偏っている場合には、バランス型受光器から出力された信号列はAC結合系で構成された受信器内部を通過する際にNRZ符号信号列の直流成分がカットされて波形劣化が生じ、伝送品質が著しく劣化してしまう。

【0021】これに対して本発明装置では、干渉ビット間位相差$\Delta\theta$が0のときに、2つのポートの出力が等しくなるようにMZ干渉計を設定する。図3は、本発明装置におけるMZ干渉計出力の干渉ビット間位相差$\Delta\theta$依存性を示す。なお、この図では、位相変調器によって与えられる位相振幅$\Delta\phi$を$\pi/2$、遅延ビット長Dを1ビットとしている。この結果、干渉ビット間の位相差$\Delta\theta$が$\pi/2$の時にはポート1から、$-\pi/2$の時にはポート2から光が出力される。この出力信号をバランス型受光器で受光すると、その出力はAMI符号信号列となる。

13　位相変調器
14　マッハツェンダ（MZ）干渉計
15　バランス型受光器
16　線形増幅器
17　3値判定識別器
20　光伝送網
21，23　Dタイプ・フリップフロップ（D・FF）
22　OR回路

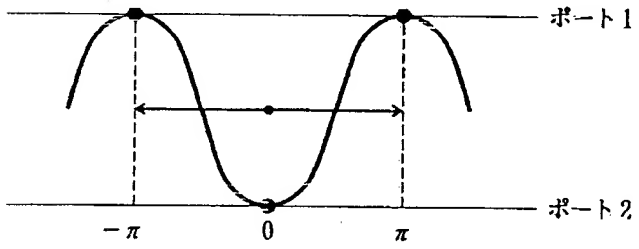
【図1】

本発明の光送受信装置の実施形態



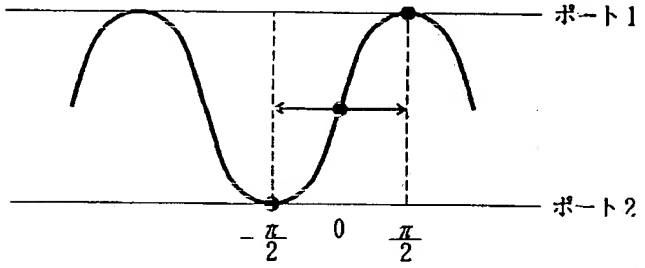
【図2】

MZ干渉計出力のΔθ依存性（従来装置）



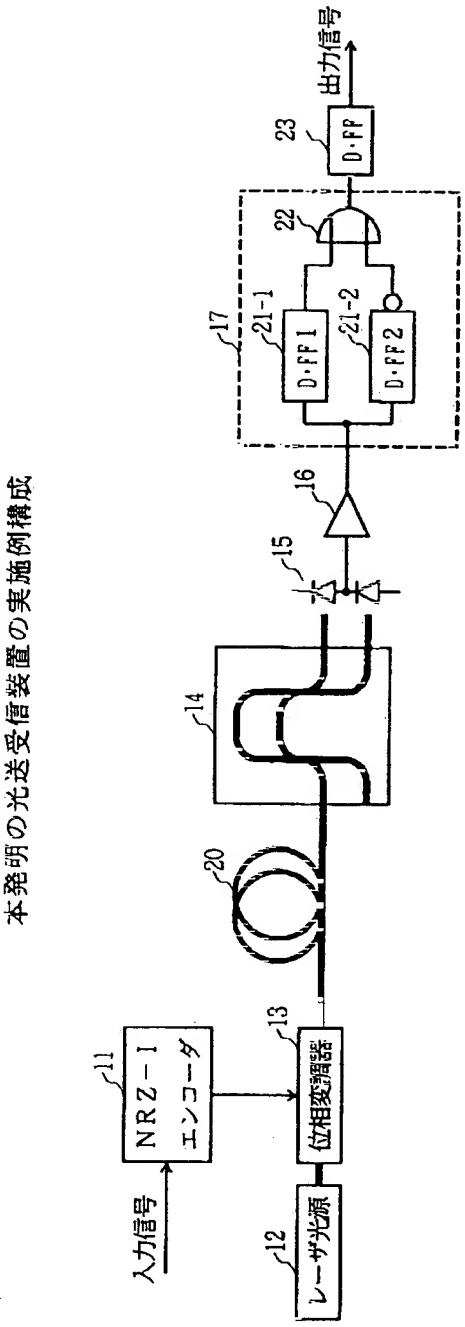
【図3】

MZ干渉計出力のΔθ依存性（本発明装置）



【図6】

本発明の光送受信装置の実施例構成



Fターム(参考) 2H047 LA00 NA02 QA03 RA08 TA00
2K002 AB09 AB13 AB18 AB40 BA06
DA07 DA08 GA07 GA10
5K002 AA01 AA03 BA00 BA02 CA14
DA06 DA14 FA01
5K004 AA05 FC02 FE00 FG00

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H04B 10/04
H04B 10/06
H04L 27/20
H04L 27/233

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(22)Date of filing : 09.11.1998

(71)Applicant : NIPPON TELEGR & TELEPH CORP <NTT>

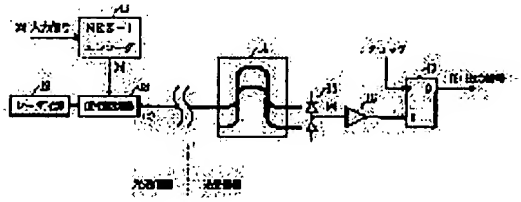
(72)Inventor : NISHIZAWA HIDEKI
YAMADA YOSHIRO

(54) OPTICAL TRANSMITTER-RECEIVER

(57)Abstract:

PROBLEM TO BE SOLVED: To avoid waveform deterioration dependent on a mark rate by providing an optical receiver with a Mach-Zehender interferometer, a balance type light receiver for photoelectric converting a signal light from the Mach-Zehender interferometer and a three value decision discriminator which identifies a signal sequence of an AMI code the balance type light receiver outputs and converts it into an NRZ code.

SOLUTION: A Mach-Zehender(MZ) interferometer 14 is set so that an output of a balance type light receiver 15 becomes not an NRZ code but an AMI code and the AMI code outputted from the balance type light receiver 15 is identification reproduced by a three value decision discriminator 17. Since the AMI code has a feature that it



has a ground level when '0' and a plus amplitude and a minus amplitude are alternately outputted when '1', it does not essentially have an AC component. Thus, even if an optical receiver is constituted by an AC connection system, waveform deterioration dependent upon a rate of mark does not occur and stable reception is enabled for any input signals.

LEGAL STATUS

[Date of request for examination]

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[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The block diagram showing the operation gestalt of the optical transmitter-receiver of this invention.
[Drawing 2] Drawing showing the deltatheta dependency (conventional equipment) of MZ interferometer output.
[Drawing 3] Drawing showing the deltatheta dependency (this invention equipment) of MZ interferometer output.
[Drawing 4] Drawing showing a signal wave form (conventional equipment).
[Drawing 5] Drawing showing a signal wave form (this invention equipment).
[Drawing 6] The block diagram showing the example configuration of the optical transmitter-receiver of this invention.
[Drawing 7] The block diagram showing the example of a configuration of the conventional optical transmitter-receiver.
[Drawing 8] The block diagram showing the example of a configuration of the conventional optical transmitter-receiver.
[Description of Notations]
11 NRZ-I Encoder
12 Laser Light Source
13 Phase Modulator
14 Mach TSUENDA (MZ) Interferometer
15 Balance Mold Electric Eye
16 Linear Amplifier
17 3 Value Judging Discrimination Circuit
20 Optical Transmission Network
21 23 D-type flip-flop (D-FF)
22 OR Circuit

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* NOTICES *

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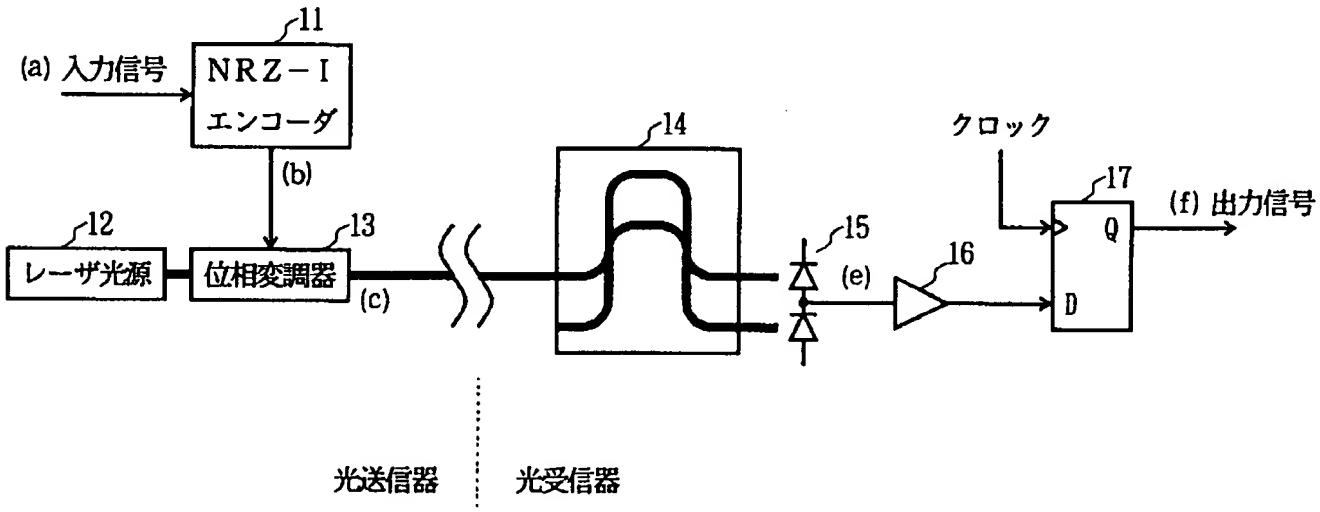
DRAWINGS

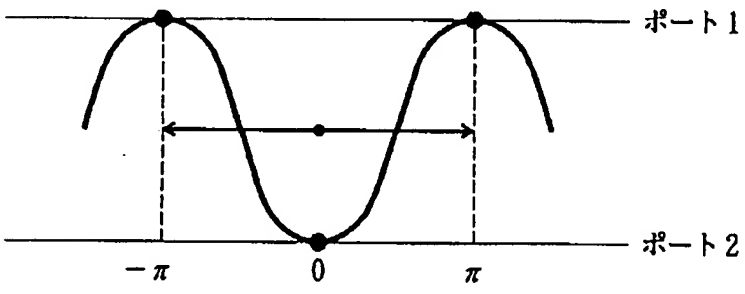
[Drawing 1]

本発明の光送受信装置の実施形態



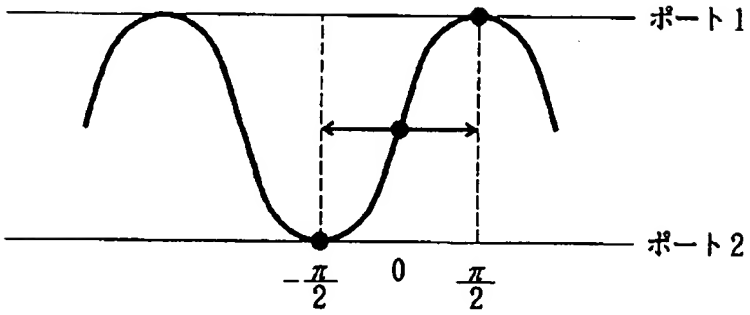
[Drawing 2]

MZ干渉計出力のΔθ依存性（従来装置）



[Drawing 3]

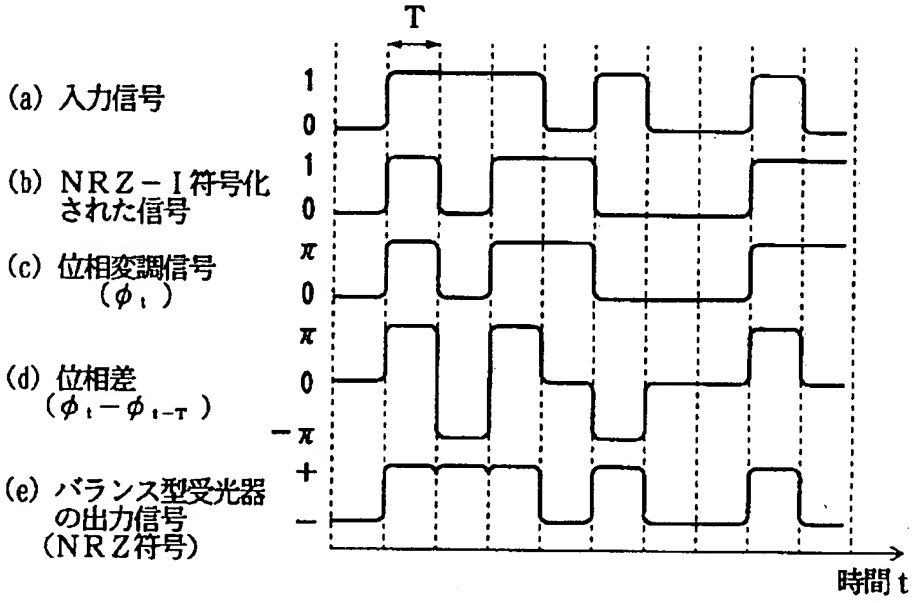
ＭＺ干渉計出力のΔθ依存性（本発明装置）



Drawing 3

[Drawing 4]

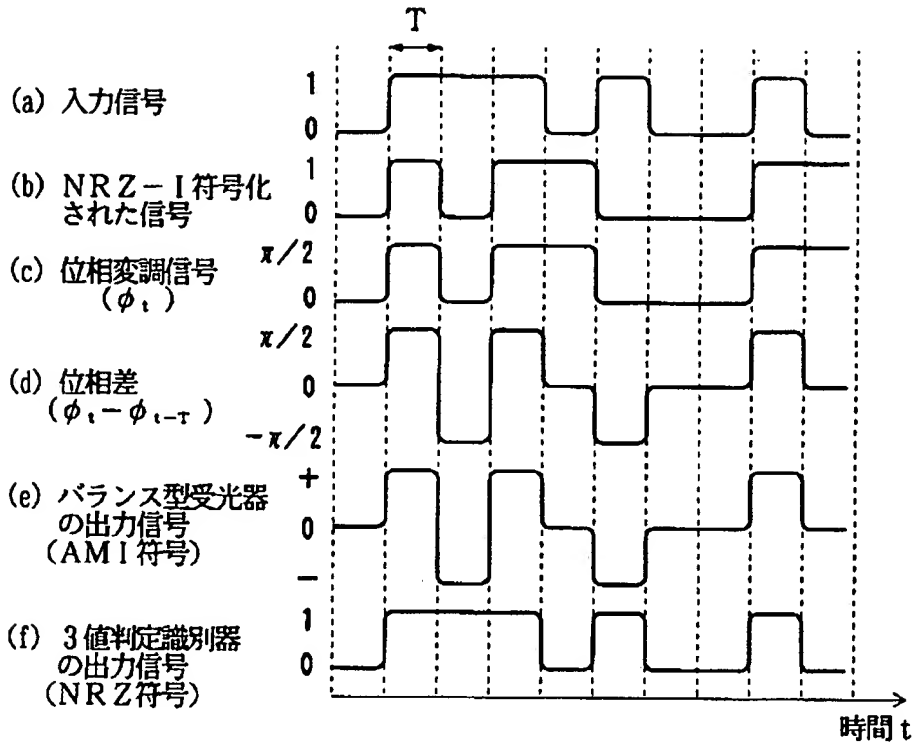
信号波形（従来装置）



Drawing 4

~~[Drawing 5]~~

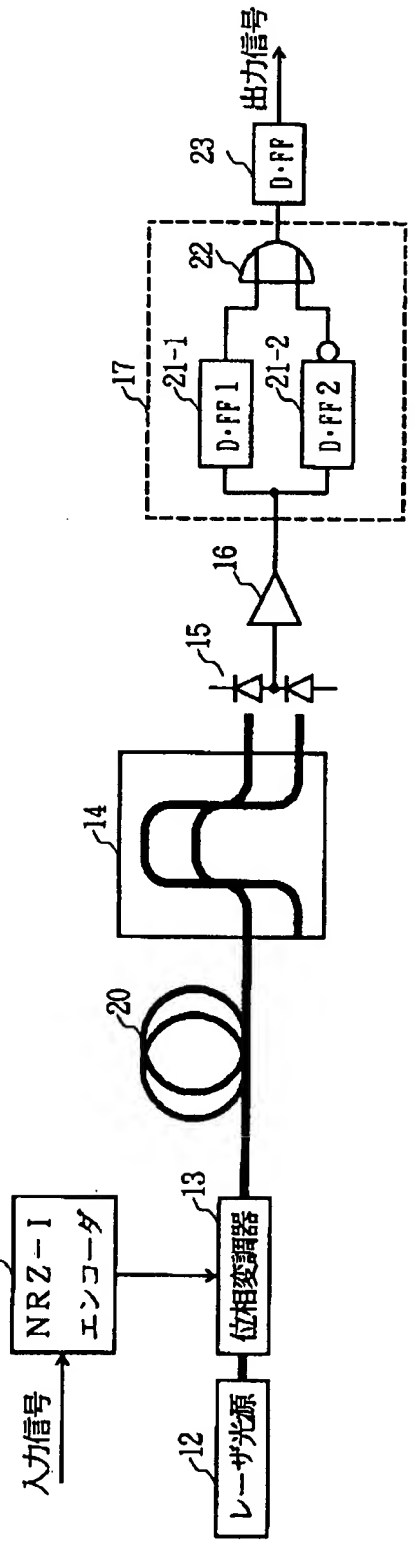
信号波形（本発明装置）



Drawing 5

~~[Drawing 6]~~

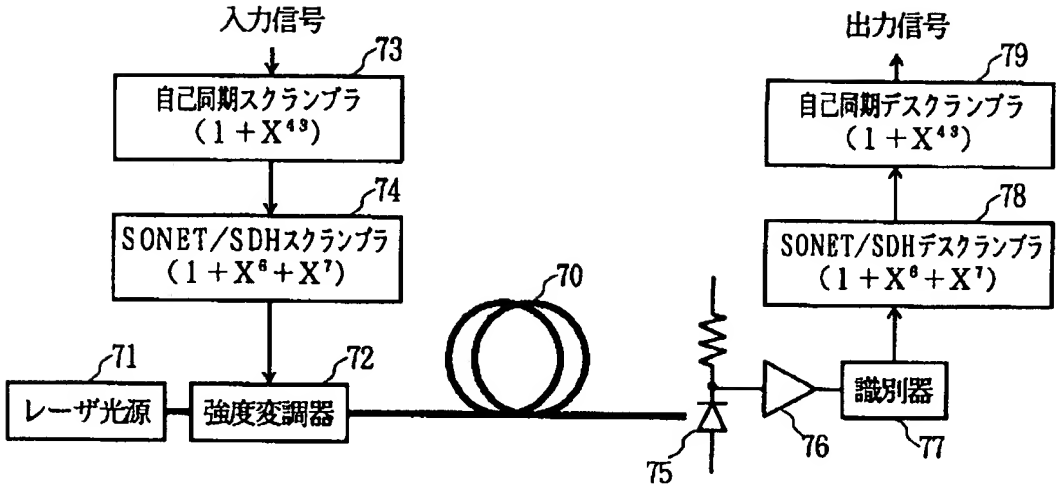
本発明の光送受信装置の実施例構成



~~Drawing 7~~

Drawing 6

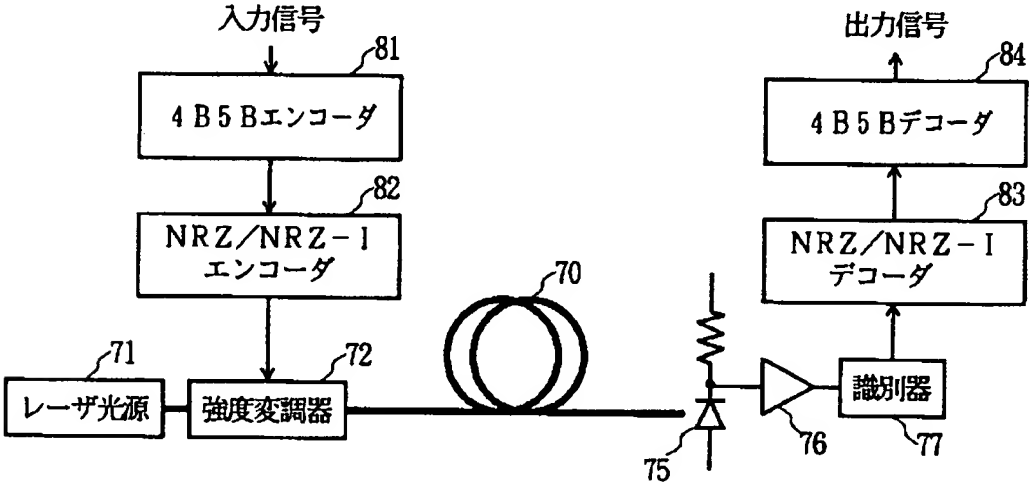
従来の光送受信装置



Drawing 7

[Drawing 8]

従来の光送受信装置



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention is used for a differential-phase-shift-modulation-direct detection (DPSK-DD) method, and relates to the suitable optical transmitter-receiver for coherent optical communication.
[0002]
[Description of the Prior Art] The optic fiber communication using the wavelength of 1.55-micrometer band progressed as a transmission means more than the middle distance in a telephone network until now, and the multiplex system "Synchronous Digital Hierarchy" (SDH) was standardized in CCITT in November, 1988. In SDH, the SDH scrambler is applied for the purpose of performing clock playback correctly from a received-data signal, and suppressing dispersion in the mark rate of a transmission signal, and receiving correctly without an error of an optical digital signal.
[0003] Moreover, although SDH is used not only the call service by which cutting tool multiplex was carried out but when transmitting an IP packet and an ATM (Asynchronous Transfer Mode) cel, in addition to an SDH scrambler, a self-synchronization scrambler is also applied in this case in recent years. In IP over SDH or ATM over SDH, this will be because compensation of optical transmission quality cannot be performed only by the SDH scrambler, if the data which one user transmitted may occupy the SDH payload section broadly and a user transmits a specific signal train.
[0004] Moreover, it is FDDI (Fiber Distributed Data Interface) to SDH having compensated optical transmission quality with the application of a scrambler. Optical transmission quality is compensated with Ethernet with an optical interface by adopting nBmB block coding (n and m being n<m at the natural number).
[0005] Drawing 7 and drawing 8 show the example of a configuration of the conventional optical transmitter-receiver which carries out optical transmission of the IP packet. An optical transmitter is constituted by a laser light source 71, the modulator 72 on the strength, the self-synchronization scrambler 73, and the SONET/SDH scrambler 74 in drawing 7 . An optical receiver is constituted by an electric eye 75, a linear amplifier 76, a discrimination circuit 77, the SONET/SDH descrambler 78, and the self-synchronization descrambler 79.
[0006] The IP packet encapsulated by PPP (Point to Point Protocol) etc. is changed into the sign which was suitable for optical transmission with the self-synchronization scrambler 73 and the SONET/SDH scrambler 74. The modulator 72 on the strength carries out intensity modulation of the laser beam outputted from the laser light source 71 with the sign, and sends it out to the optical transmission network 70. The transmitted lightwave signal train is changed into an electrical signal train by the electric eye 75, and after being amplified with a linear amplifier 76, discernment playback of it is carried out by the discrimination circuit 77. Inverse transformation of the reproduced signal train is carried out

to the signal train at the time of an input by the SONET/SDH descrambler 78 and the self-synchronization descrambler 79, and it is outputted to it.
[0007] An optical transmitter is constituted by a laser light source 71, the modulator 72 on the strength, the 4 B5B encoder 81, and the NRZ/NRZ-I encoder 82 in drawing 8 . An optical receiver is constituted by an electric eye 75, a linear amplifier 76, a discrimination circuit 77, the NRZ / NRZ-I decoder 83, and the 4 B5B decoder 84.
[0008] An input signal is changed into the sign which was suitable for optical transmission with the 4 B5B encoder 81 and the NRZ/NRZ-I encoder 82. The modulator 72 on the strength carries out intensity modulation of the laser beam outputted from the laser light source 71 with the sign, and sends it out to the optical transmission network 70. The transmitted lightwave signal train is changed into an electrical signal train by the electric eye 75, and after being amplified with a linear amplifier 76, discernment playback of it is carried out by the discrimination circuit 77. Inverse transformation of the reproduced signal train is carried out to the signal train at the time of an input by the NRZ/NRZ-I decoder 83 and the 4 B5B decoder 84, and it is outputted to it.
[0009]
[Problem(s) to be Solved by the Invention] In the conventional example shown in drawing 7 and drawing 8 , creation becomes very difficult as the bit rate of a signal goes up these electrical circuits, although a scrambler and a nBmB encoder are indispensable in order to compensate optical transmission quality, and they are dozens Gbit/s. Application to the high-speed optical communication of a class is difficult.
[0010] Moreover, the configuration of drawing 7 using a scrambler cannot necessarily compensate omnipotent for optical transmission quality to the sign train of arbitration, under the limited conditions which exist although a probability is small, optical transmission quality cannot be compensated but a synchronization may generate a gap and a bit error at the time of optical reception. Furthermore, in SONET / SDH scrambler, and SONET / SDH descrambler, in order to make the beginning of a false random pattern in agreement, it is necessary to take frame synchronization between scrambler-descramblers.
[0011] On the other hand, with the configuration of drawing 8 using a nBmB encoder, the bit rate of the signal train outputted from an encoder will become 1.25 times of the bit rate of a signal train inputted into an encoder, and transmission efficiency will fall about twenty percent.
[0012] For this invention, the signal train inputted into a discrimination decision circuit in order to solve the above-mentioned trouble is AMI (Alternate Mark Inversion). The DPSK-DD method which becomes a sign is realized and it aims at offering the optical transmitter-receiver which can avoid wave degradation depending on a mark rate.
[0013]
[Means for Solving the Problem] In the optical transmitter-receiver equipped with the optical transmitter which outputs the phase modulation light by which differential coding of this invention was carried out, and the optical receiver to which receive this phase modulation light and it restores an optical transmitter The encoder which changes the input signal of an NRZ code into the signal of an NRZI code, It has the phase modulator which outputs the phase modulation light which gave phase amplitude deltaphi in the range of 0<delta phi<pi to the mark and tooth space which were encoded by the encoder. An optical receiver Dichotomize the phase-modulation light which received and delay bit length D to one signal light is set up in 0< D<2. The Mach-Zehnder interferometer adjusted so that the optical reinforcement outputted from two output ports might become equal when phase contrast deltatheta between both the signals that both signals light was made to interfere, and changed and interfered in on-the-strength strange modulated light was 0, It has the balance mold electric eye which carries out photo electric conversion of the signal light from 2 output ports of a Mach-Zehnder interferometer, and outputs the difference of the changed electrical signal, and 3 value judging discrimination circuit which identifies

the signal train of the AMI sign outputted from a balance mold electric eye, and is changed into the signal train of an NRZ code.
[0014] Moreover, it is desirable to set phase amplitude deltaphi given with a phase modulator as pi/2.
[0015]
[Embodiment of the Invention] Drawing 1 shows the operation gestalt of the optical transmitter-receiver of this invention. An optical transmitter is constituted by the NRZ/NRZ-I encoder 11 which changes into an NRZI code the input signal encoded by NRZ, a laser light source 12, and the phase modulator 13 in drawing. An optical receiver is constituted by the Mach TSUENDA (MZ) interferometer 14 changed into the on-the-strength strange modulated light according to the phase contrast of a receiving lightwave signal, the balance mold electric eye 15, a linear amplifier 16, and 3 value judging discrimination circuit 17.
[0016] The description of this operation gestalt sets up the MZ interferometer 14 so that the output of the balance mold electric eye 15 may become an AMI sign instead of an NRZ code, and it is in the place which carries out discernment playback of the AMI sign outputted from the balance mold electric eye 15 by 3 value judging discrimination circuit 17.
[0017] Here, it is made to correspond with the conventional DPSK-DD method, and actuation of this operation gestalt is explained. In addition, when an input signal is "1", the sign which reversed the last sign, and the signal of an NRZI code which turns into the last sign and an equal sign in the case of "0" are generated, and by the signal of this NRZI code, the phase modulation of the light non-become irregular is carried out, it transmits, and a DPSK-DD method is a method which detects this phase-modulation light directly by the balance mold electric eye in a receiving side.
[0018] When phase contrast deltatheta between the bits in which it interfered with MZ interferometer is 0 in the case of the conventional DPSK-DD method, MZ interferometer is adjusted so that only one side of two output ports of MZ interferometer may output light. The phase contrast between interference bits deltatheta dependency of MZ interferometer output in this case is shown in drawing 2 . Drawing 2 shows the case where phase amplitude deltaphi given by the phase modulator is set up so that it makes pi and delay bit length D into 1 bit, and light may output to a port 2, when deltatheta is 0, and when deltatheta is set to pi and -pi, light is outputted to a port 1. If this is received by the balance mold electric eye, the output of an electric eye will serve as an NRZ code signal train.
[0019] Drawing 4 shows the situation of change of a signal wave form until an NRZ code signal train is reproduced. Input signal of an NRZ code (a) Signal NRZI-code-ized by the encoder (b) It is changed, a phase modulation is carried out by phase amplitude delta phi=pi by the phase modulator, and it is phase modulation signal phit. (c) It becomes. Phase contrast between the ******** bits of this signal train (phi t-phi t-T) (d) Since it becomes 3 value code-signal train of pi, 0, and -pi, when it is made to interfere with MZ interferometer set up like drawing 2 and light is received by the balance mold electric eye, that output is the output signal (e) of an NRZ code as shown in drawing. It becomes.
[0020] Now, in case the signal train to which the reproduced NRZ code signal train was outputted from the balance mold electric eye when the mark rate of an input signal train was greatly partial temporarily, although discernment playback was performed using binary judging discrimination decision circuits, such as D-FF, passes through the interior of a receiver which consisted of AC coupled systems, the dc component of an NRZ code signal train will be cut, wave degradation will produce it, and the transmission quality will deteriorate remarkably.
[0021] On the other hand, with this invention equipment, when phase contrast between interference bits deltatheta is 0, MZ interferometer is set up so that the output of two ports may become equal. Drawing 3 shows the phase contrast between interference bits deltatheta dependency of MZ interferometer output in this invention equipment. In addition, in this drawing, pi/2 and delay bit length D are made into 1 bit for phase amplitude deltaphi given by the phase modulator. Consequently, when phase contrast deltatheta between interference bits is pi/2, at the time of -pi/2, light is outputted from a port 2 from a

port 1. If this output signal is received by the balance mold electric eye, that output will serve as an AMI code-signal train.
[0022] Drawing 5 shows the situation of change of a signal wave form until an AMI code-signal train is generated. Input signal of an NRZ code (a) It is an NRZI code (b) by the NRZ/NRZ-I encoder 11. It is changed, a phase modulation is carried out by phase amplitude delta phi=pi / 2 by the phase modulator 13, and it is phase modulation signal phit. (c) It becomes. Phase contrast between the ******** bits of this signal train (phi t-phi t-T) (d) As shown in drawing, since it becomes 3 value code-signal train of pi/0, and -pi/2, when it is made to interfere with the MZ interferometer 14 set up like drawing 3 and light is received by the balance mold electric eye 15, that output is the output signal (e) of an AMI sign. It becomes. [2 and 0] This output signal (e) When it identifies by 3 value judging discrimination circuit 17, it is the output signal (f) of an NRZ code. It is obtained.
[0023] The big difference from equipment is the point that the output signal of a balance mold electric eye is not an NRZ code but an AMI sign, this invention equipment and conventionally. An AMI sign does not have a dc component in essence from the amplitude of plus and the amplitude of minus having the description outputted by turns at a grand level and the time of "1" at the time of "0." For this reason, even if the receiver consists of AC coupled systems, it does not generate but wave degradation depending on a mark rate like equipment before becomes receivable [which it was stabilized to any input signal trains]. When this invention equipment is used, even if it uses neither a scrambler nor a nBmB encoder, quality optical communication becomes possible from the above reason.
[0024] Furthermore, since whenever [phase modulation] ends with the half amplitude compared with equipment conventionally when a phase modulation is performed by phase amplitude delta phi=pi / 2, it is effective in the ability to reduce the power consumption by the driver inside an optical transmitter by half.
[0025] Drawing 6 shows the example configuration of the optical transmitter-receiver of this invention. An optical transmitter is constituted by NRZ / NRZ-I encoder 11, a laser light source 12, and the phase modulator 13 in drawing. The optical receiver connected to an optical transmitter through the optical transmission network 20 is constituted by the MZ interferometer 14 changed into the on-the-strength strange modulated light according to the phase contrast of a receiving lightwave signal, the balance mold electric eye 15, a linear amplifier 16, two d-type flip-flops (D-FF) 21-1 that have a threshold different, respectively, 21-2, OR circuit 22, and D-FF23. In addition, 3 value judging discrimination circuit 17 is constituted by D-FF 21-1, 21-2, and OR circuit 22.
[0026] It is changed into an NRZI code signal train, for example, the NRZ code signal train inputted into the NRZ/NRZ-I encoder 11 is LiNbO3. The phase modulator 13 which consists of optical waveguide formed is driven. A phase modulator 13 carries out the phase modulation of the laser beam outputted from the laser light source 12 to an NRZI code.
[0027] The signal light modulated by the phase modulator 13 is inputted into the MZ interferometer 14 through the optical transmission network 20. The MZ interferometer 14 branches the inputted signal light, and it is delayed 1 bit in the signal of branched one side, and both signals are made to interfere in it, and it generates on-the-strength strange modulated light. By the balance mold electric eye 15, the changed on-the-strength strange modulated light is changed into an electrical signal, and is outputted as an AMI code-signal train. This electrical signal is amplified with amplifier 16, and is inputted into 3 value judging discrimination circuit 17.
[0028] D-FF 21-1 of 3 value judging discrimination circuit 17 outputs "1", only when the sign which has a threshold in potential higher than a grand level, and has the amplitude in a plus side among one sign of an AMI code-signal train inputs. On the other hand, D-FF 21-2 outputs "1", only when the sign which has a threshold in potential lower than a grand level, and has the amplitude in a minus side among one sign of an AMI code-signal train inputs. Two outputs from D-FF 21-1 and D-FF 21-2 are outputted as an RZ code-signal train by carrying out OR by OR circuit 22. Thus, 3 value judging discrimination circuit

17 changes the inputted AMI code-signal train into RZ code-signal train. RZ code-signal train outputted from 3 value judging discrimination circuit 17 is changed and outputted to an NRZ code signal train by D-FF23.

[0029]

[Effect of the Invention] As explained above, the optical transmitter-receiver of this invention can make the signal wave form after carrying out balance reception in a DPSK-DD method into an AMI sign. For this reason, even if the receiver consists of AC coupled systems, it does not generate but wave degradation depending on a mark rate like equipment before becomes receivable [which it was stabilized to any input signal trains]. Therefore, when this invention equipment is used, even if it does not use a scrambler and an encoder, quality optical communication becomes possible. Moreover, transmission efficiency does not fall like [at the time of using nBmB block coding].

[0030] Furthermore, since a phase modulation factor ends with the half amplitude at least compared with equipment conventionally when phase amplitude deltaphi in a phase modulator is made into pi/2, the power consumption by the driver inside a transmitter is sharply reducible.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] In the optical transmitter-receiver equipped with the optical transmitter which outputs the phase modulation light by which differential coding was carried out, and the optical receiver to which receive this phase modulation light and it restores said optical transmitter The encoder which changes the input signal of an NRZ code into the signal of an NRZI code, It has the phase modulator which outputs the phase modulation light which gave phase amplitude deltaphi in the range of 0<delta phi<pi to the mark and tooth space which were encoded by said encoder. Said optical receiver Dichotomize said phase-modulation light which received and delay bit length D to one signal light is set up in 0< D<2. The Mach-Zehnder interferometer adjusted so that the optical reinforcement outputted from two output ports might become equal when phase contrast deltatheta between both the signals that both signals light was made to interfere, and changed and interfered in on-the-strength strange modulated light was 0, The balance mold electric eye which carries out photo electric conversion of the signal light from 2 output ports of said Mach-Zehnder interferometer, and outputs the difference of the changed electrical signal, The optical transmitter-receiver characterized by having 3 value judging discrimination circuit which identifies the signal train of the AMI sign outputted from said balance mold electric eye, and is changed into the signal train of an NRZ code.
[Claim 2] The optical transmitter-receiver characterized by setting phase amplitude deltaphi given with said phase modulator as pi/2 in an optical transmitter-receiver according to claim 1.

[Translation done.]